THE RUBIACEAE OF OHIO[1]

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Eight genera and twenty-seven species, of which six are rare in their distribution, are recognized in this study as constituting a part of Ohio's flora. *Galium*, represented by fifteen species, is the largest genus. Five other genera, *Asperula*, *Cephalanthus*, *Mitchella*, *Sherardia*, and *Spermacoce*, consist of a single species. *Asperula odorata* L., *Diodia virginiana* L., and *Galium palustre* L., are new reports for the state. Typically members of the Rubiaceae in Ohio are herbs with the exception of *Cephalanthus occidentalis* L., a woody shrub, and *Mitchella repens* L., an evergreen, trailing vine.

In this paper data pertinent to the range, habitat, and distribution of Ohio's species of the Rubiaceae are given. The information was compiled from my examination of approximately 2000 herbarium specimens obtained from seven herbaria located within the state, those of Kent State University, Miami University, Oberlin College, The Ohio State University, Ohio Wesleyan University, and University of Cincinnati. Limited collecting and observations in the field during the summers of 1959 through 1962 supplemented herbarium work.

In the systematic treatment, dichotomous keys are constructed to the genera and species occurring in Ohio. Following the species name, colloquial names of frequent usage and synonyms as indicated in current floristic manuals are listed. A general statement of the habitat as compiled from labels on herbarium specimens and personal observations is given for each species, as well as a statement of its frequency of occurrence and range in Ohio. An indication of the flowering time follows this information.

The frequency of occurrence is determined according to the following scale based on the number of collecting stations: *rare* if from less than 10 stations, *infrequent* if from 10 to 30 stations, *frequent* if from 31–50 stations, and *common* if from more than 50 stations.

For species designated as *rare*, all information recorded on each herbarium specimen is given. The county name is first; this is followed by these data (when available): location, date, collector, and habitat. Also included are the abbreviations of the herbaria in which a specimen is located. The abbreviations are those given by Lanjouw and Stafleu in the fourth edition of *Index Herbariorum* (1959).

Included in the discussion of each species is an indication as to whether the species is native, introduced, naturalized, or adventive. This indication of status is based on information obtained from *Gray's Manual of Botany* (Fernald, 1950), the new *Britton* and *Brown Illustrated Flora* (Gleason, 1952), and *Taxonomy of Vascular Plants* (Lawrence, 1951).

The diversity and overlapping of diagnostic characteristics among species of widely distributed genera, e.g., *Houstonia* and *Galium*, has resulted in various taxonomic alignments. The fact that *Hedyotis* L., *Houstonia* L., and *Oldenlandia* L. have been merged under *Hedyotis* by Fosberg (1954) and Lewis (1961) is indicative of the problem. The taxonomic treatment throughout this paper closely follows that of Fernald (1950) and Gleason (1952); in following their treatment *Houstonia* is maintained as a separate genus.

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[1]Based in part on a thesis, the Rubiales of Ohio, submitted to the Graduate School of Kent State University in partial fulfillment of the requirements for the Degree Master of Arts.

[2]I wish to express my thanks to Dr. Tom S. Cooperrider, who directed parts of this study, for his interest and advice, and also to the curators of the herbaria from which specimens were borrowed.

Cytological studies in the Rubiaceae reveal that the family is multibasic with numbers of X=9, 10, 11, 12, and 14 having been reported (Darlington and Wylie, 1956). Lewis (1962) states that about 6 per cent of the species comprising the Rubiaceae have known chromosome numbers; however, chromosome numbers are known for twenty of the twenty-seven species considered in this study. Table 1 represents a summary of the chromosome data available; only the somatic or diploid number is given. Particularly noteworthy is the high incidence of polyploidy prevalent among various genera; *Galium*, e.g., consists of at least seven polypoid species. *Galium* is also multibasic and morphologically distinct sections of the genus have different base numbers.

TABLE 1

Summary of chromosome data available for species of Rubiaceae considered in this study.

Taxon	Chromosome No. (2n)	Literature Reference
Asperula (X=11)		
odorata L.	44	Darlington & Wylie, 1956
odorata L.	44	Cave et. al., 1958–60
Cephalanthus (X=11)		
occidentalis L.	44	Darlington & Wylie, 1956
Diodia (X=14)		
teres Walt.	28	Jinno, 1956
teres Walt.	28	Lewis, 1962
virginiana L.	28	Lewis, 1962
Galium (X=11, 12)		
aparine L.	42	Skalinska et. al., 1959
aparine L.	44	Lewis, 1962
boreale L.	44, 66	Löve & Löve, 1954
boreale L.	66	Lewis, 1962
circaezans Michx.	22	Lewis, 1962
mollugo L.	22, 44, 55, 66	Darlington & Wylie, 1956
mollugo L.	22, 44	Cave et. al., 1958–60
obtusum Bigel.	48	Lewis, 1962
palustre L.	24, 48, 96	Darlington & Wylie, 1956
pilosum Ait.	22	Lewis, 1962
tinctorium L.	24	Lewis, 1962
trifidum L.	24	Darlington & Wylie, 1956
verum L.	44	Skalinska et. al., 1959
verum L.	22, 44	Darlington & Wylie, 1956
Houstonia (X=9)		
caerulea L.	36	Darlington & Wylie, 1956
canadensis Willd.	18	Terrell, 1959
purpurea L.	18	Terrell, 1959
Mitchella (X=11)		
repens L.	22	Darlington & Wylie, 1956
Sherardia (X=11)		
arvensis L.	22	Cave et. al., 1958–60
Spermacoce (X=14)		
glabra Michx.	28	Lewis, 1962

RUBIACEAE (Madder Family)

Leaves simple, opposite or whorled, usually stipulate, margins entire; flowers bisexual, epigynous, gamopetalous, actinomorphic, dimorphic in *Houstonia* and *Mitchella*; corolla rotate, tubular, salverform or funnelform; calyx adherent to the ovary; stamens as many as the corolla lobes, usually four or five, the anthers distinct, two-celled, dehiscing longitudinally; pistil one, the ovary usually two-loculed, style simple or two-cleft as in *Diodia* and *Sherardia*, styles two in *Galium*, stigmas usually two, four in *Mitchella*; fruits various, a dehiscent capsule in *Houstonia*, a fleshy berry in *Mitchella*, a septicidal capsule in *Spermacoce* splitting when ripe into two carpels, or fruits separating at maturity into indehiscent nutlets in other genera.

KEY TO GENERA

1. Woody shrubs or small trees; flowers in large, terminal, spherical heads..... *Cephalanthus*
1. Herbs or trailing vines; flowers not in large, terminal, spherical heads..... 2
2. Evergreen; trailing vines; leaves round-ovate; stigmas four; fruit a fleshy berry..... *Mitchella*
2. Non-evergreen; herbs; leaves not round-ovate; stigmas one or two; fruits dry..... 3
3. Principl leaves whorled..... 4
4. Flowers involucrate, subtended by several bracts united below..... Sherardia
4. Flowers exinvolucrate..... 5
5. Corolla funnelform, the tube very slender; leaves in whorls of eight only.. *Asperula*
5. Corolla rotate or nearly so, the tube very short, leaves usually in whorls of less than eight..... *Galium*
3. Principal leaves opposite..... 6
6. Flowers terminal, pediceled, solitary or in cymose clusters..... *Houstonia*
6. Flowers axillary, sessile..... 7
7. Stipules dissected into filiform segments; flowers in dense clusters..... *Spermacoce*
7. Stipules linear; flowers in clusters of two or three or solitary..... *Diodia*

CEPHALANTHUS L. (Buttonbush)

1. *Cephalanthus occidentalis* L.
Common. Throughout the state. In wet fields and woods, roadside ditches, swamps, bogs, and marshes. July-Aug. Native.

MITCHELLA L. (Partridge-Berry)

1. *Mitchella repens* L.
Common. Throughout most of the state with the exception of the northwestern corner where there is a report from Wood County. Abundant in woods and on wooded ravines, slopes, and hillsides. June-July. Native.

SHERARDIA L. (Field Madder)

1. *Sherardia arvensis* L.
Rare. Widely scattered only in northeastern Ohio from Harrison to Ottawa Counties. May-Sept. Introduced from Europe.

CUYAHOGA: Berea, escaped from gardens, J. N. Watson, 1894, (OS).
HARRISON: German Twp., ¼ mile north of Annapolis, A. W. Cusick, July 8, 1959, (OS).
LAKE: Kirtland Hills, H. C. Beardslee and F. J. Tyler, Aug. 29, 1936, (OS).
OTTAWA: South Bass Is., close clipped lawn, R. B. Gordon, Aug. 7, 1950, (OS).

ASPERULA L. (Sweet Woodruff)

1. *Asperula odorata* L.
Rare. Only one report for the state from Summit County. May. According to Gleason (1952) the species is rarely introduced; native of Eurasia and North Africa. Known to escape from cultivation.

SUMMIT: Ervin M. Herrick, May 1, 1955, (OS).
No other data was given on the herbarium specimen.

In order to establish the status of the species it was necessary to communicate personally with the collector. Examination of his field notes indicated that the plant was collected on an east-facing slope in a beech-maple woods, about 500 ft from the edge of the woods. It was found growing alongside a large colony of *Galium* and was originally mistaken for a species of that genus. The exact location of the collecting station is Twinsburg Twp., west of Route 91, near Crown Hill Cemetery.

GALIUM L. (Bedstraws, Cleavers)

KEY TO SPECIES

1. Inflorescences compact, many-flowered, in a dense panicle from the upper axils, or inflorescences repeatedly forked in a terminal cyme..... 2
1. Inflorescences a many-flowered, open, repeatedly forked terminal cyme; leaves blunt at the tips, in whorls of 2–4..... 1. *G. palustre*
2. Inflorescences numerous from the upper axils, forming a compact many-flowered panicle; leaves not blunt at the tips, in whorls of 4–8..... 3
3. Leaves three-nerved, in whorls of 4..... 2. *G. boreale*
3. Leaves one-nerved, in whorls of 6–8..... 3. *G. verum*
1. Inflorescence simple, few-flowered, or inflorescences few to several forming a loose open panicle or cyme..... 4
Leaves distinctly three-nerved or more, always in whorls of 4, oval, elliptical, or lanceolate..... 5
5. Stems and leaves densely hirsute; flowers and fruits pediceled..... 4. *G. pilosum*
5. Stems and leaves not densely hirsute; flowers and fruits sessile or nearly so..... 6

6. Leaves pubescent beneath, oval or elliptical; stems with few scattered hairs or slightly pubescent; corolla pilose.....5. *G. circaezans*
6. Leaves finely pubescent beneath, lanceolate, tapering to an acuminate apex; stems and corolla glabrous.....6. *G. lanceolatum*

4. Leaves one-nerved, in whorls of 4–8..... 7
7. Flowers and fruits on distinct pedicels; fruits uncinate-hispid..... 8
8. Stems retrorsely-hispid on the angles; leaves retrorsely-hispid on the margins, principal leaves in whorls of 8.....7. *G. aparine*
8. Stems not retrorsely-hispid on the angles; leaves scabrous on the margins, principal leaves in whorls of 6.....8. *G. triflorum*

7. Flowers and fruits on short pedicels, nearly sessile; fruits glabrous or granulose.. 9
9. Principal leaves in whorls of more than four.....10
10. Stems retrorsely-hispid or scabrous on the angles; leaf margin retrorsely-scabrous.....9. *G. asprellum*
10. Stems and leaf margins not retrorsely-hispid or scabrous.....11
11. Leaves sharply acute at the apex, apiculate or mucronate, scabrous or ciliate on the margins 12
12. Principal leaves in whorls of 6–8, scabrous on the margins; stem glabrous.....10. *G. mollugo*
11. Leaves not apiculate or mucronate, eciliate, never scabrous.... 12. *G. tinctorium*

9. Principal leaves in whorls of 4 or less.....13
13. Leaves strongly reflexed; lateral branches much exceeding the inflorescence.....13. *G. labradoricum*
13. Leaves not reflexed; lateral branches not exceeding the inflorescence.14
14. Stems and pedicels retrorse-scabrous; leaves linear-spatulate, 5–15 mm long; corolla 3-lobed.....14. *G. trifidum*
14. Stems and pedicels not retrorse-scabrous; leaves obtuse, 8–30 mm long; corolla 4-lobed.....15. *G. obtusum*

1. *Galium palustre* L.
Rare. A new report for the state from the extreme northeastern corner. July-August. Native.
ASHTABULA: Five miles S.E. of Pierpont near the Penn. line, marshy ground along the east branch of the Ashtabula River, Tom S. Cooperrider, July 6, 1960, (KE).
2. *Galium boreale* L. (Northern Bedstraw)
Infrequent. Generally restricted to northern Ohio. In sphagnum bogs, edges of lakes, ponds, and marshes, often in tamarack bogs. July-Sept. Native.
3. *Galium verum* L. (True Bedstraw)
Infrequent. Widely scattered in southern and northeastern Ohio. Found along roadsides, curb lawns, vacant lots, and open fields. June-August. Introduced from Europe.
4. *Galium pilosum* Ait. (Hairy Bedstraw)
Infrequent. Widely scattered throughout most of Ohio. Found in dry, open woods and meadows. June-July. Native.
5. *Galium circaezans* Michx. (Wild Licorice)
Galium hypomalacum Fern.
Common. Throughout the state. In dense, moist woods, wooded stream banks, and edges of woods near lakes, ponds, and marshes. June-July. Native.
6. *Galium lanceolatum* Torr. (Lance-Leaved Bedstraw)
Infrequent. Generally restricted to the eastern and southern parts of Ohio. In open, dry woods on sandstone outcrops and exposures. June-July. Native.
7. *Galium aparine* L. (Cleavers, Goosegrass)
Galium spurium L.
Galium vaillantii DC.
Common. Throughout the state. In open woods, wooded ravines, marshy and wet open fields, and floodplains of streams. May-July. Native.
8. *Galium mollugo* L.
Infrequent. Widely scattered in Ohio. Found along roadsides and railroad tracks. June-August. Naturalized from Europe.
9. *Galium triflorum* Michx. (Sweet-Scented Bedstraw)
Common. Throughout the state. In swamp forests, wet woods, wooded stream banks, and moist, open fields along edges of woods. May-August. Native.
10. *Galium asprellum* Michx. (Rough Bedstraw)
Frequent. Generally restricted to the eastern half of Ohio. Along roadside ditches, swamps, wooded slopes of stream banks, and moist, open fields along edges of woods. July-Sept. Native.
11. *Galium concinnum* T. & G. (Elegant Bedstraw)
Common. Throughout Ohio. In dry, open woods, thckets, roadsides, wooded stream banks, and vacant woodlots. June-August. Native.

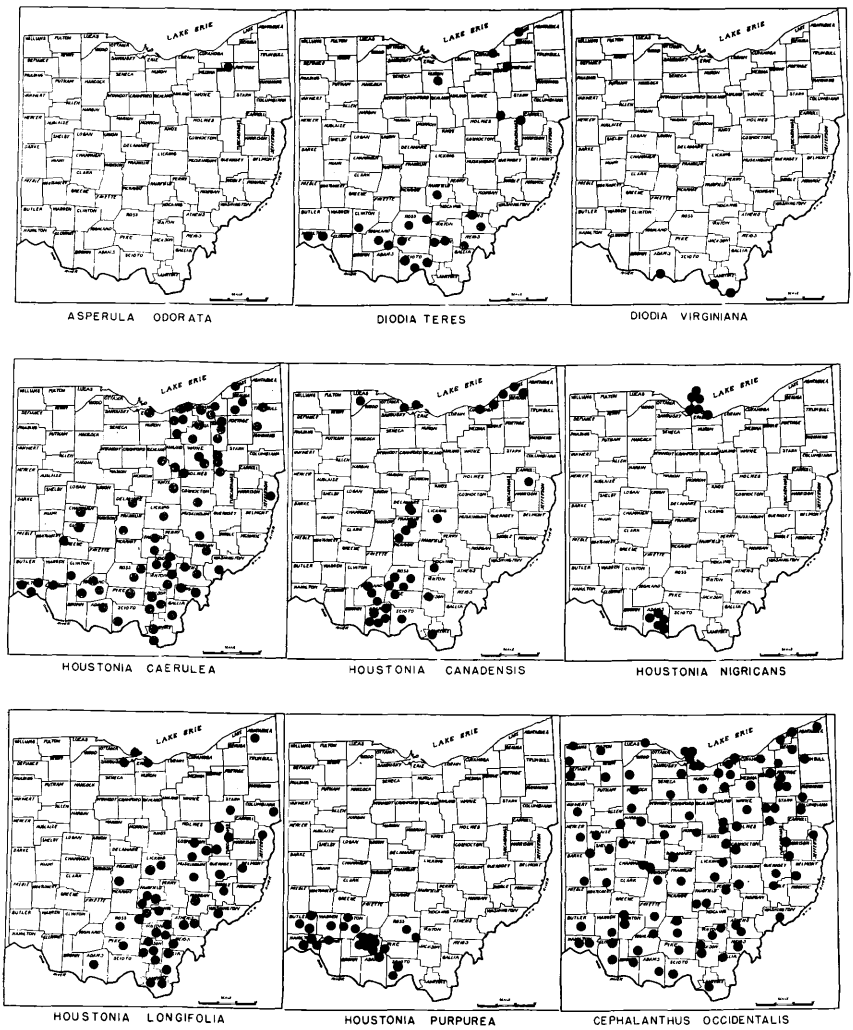

FIGURE 1. Distribution maps of species of *Asperula*, *Diodia*, *Houstonia*, and *Cephalanthus* in Ohio. Each symbol on a map represents a specific location from which an herbarium specimen was collected.

12. *Gallium tinctorium* L.
Galium claytonia Michx.
Frequent. Throughout the state. In wet sedge meadows, bogs, borders of lakes and swamps, and wet stream banks. June-August. Native.
13. *Galium labradoricum* Wig.
Rare. Known only from Portage County. May-July. Native.
PORTAGE: Mantua Twp., abundant in sphagnum bog, Almon N. Rood, May 21, 1933, (OS); two miles west of Streetsboro, near Rt. 303, sphagnum bog in Tinkers Creek Valley, Tom S. Cooperrider, June 18, 1960, (KE).
14. *Galium trifidum* L. (Three-Clefted Bedstraw)
Frequent. Throughout most of the state. Near sphagnum bogs, swamps, marshes, and rich, moist woods. July-Sept. Native.
15. *Galium obtusum* Bigel.
Galium filifolium Small
Frequent. Throughout the state. Found on rich, moist soil of woods, roadsides, stream banks, and flood plains. May-July. Native.

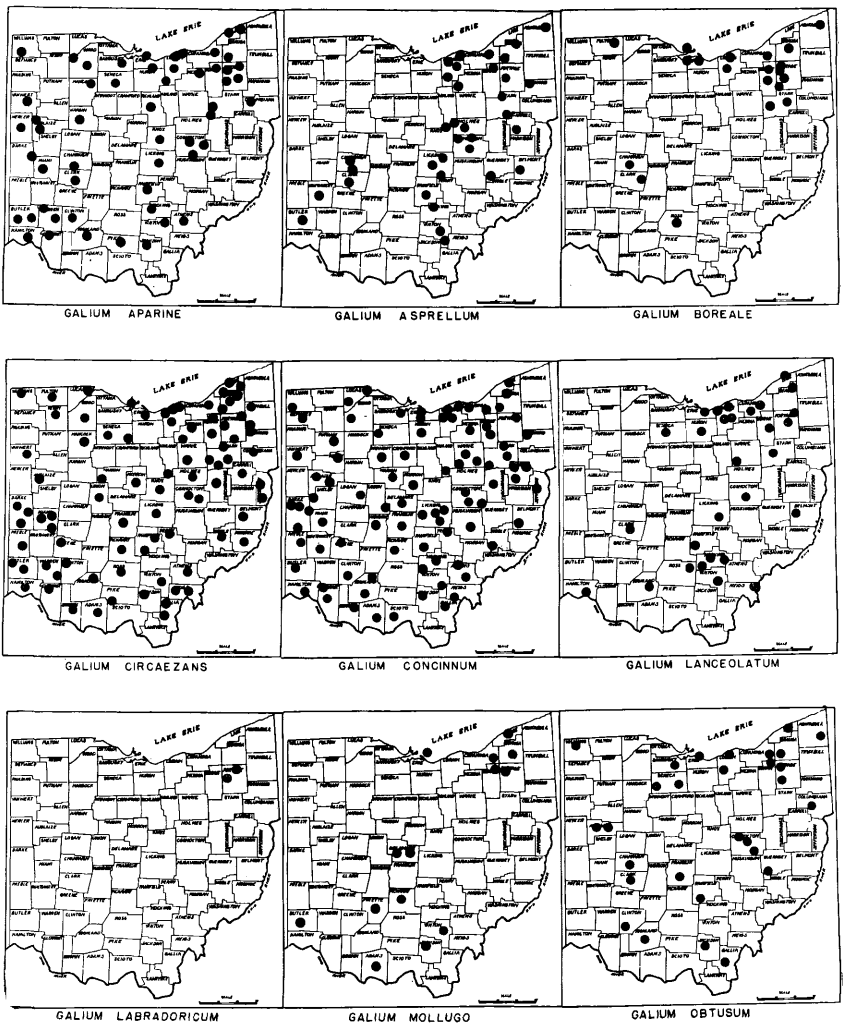

FIGURE 2. Distribution maps of nine species of *Galium* in Ohio.

HOUSTONIA L. (Bluets)

KEY TO SPECIES

1. Peduncles not branching, single flowered; corolla salverform; stamens included..... 1. *H. caerulea*
1. Peduncles branching, flowers in cymes; corolla funnelform; stamens exserted..... 2
   2. Flowers sessile or nearly so; stipules with bristle-like tips.....2. *H. nigricans*
   2. Flowers distinctly pediceled; stipules without bristle-like tips..... 3
      3. Stems glabrous to sparcely pubescent; cauline leaves lanceolate to ovate, 2.5–5 mm wide, usually three-nerved or more.....3. *H. purpurea*
      3. Stems puberulent to densely pubescent or scabrous pubescent, cauline leaves oblanceolate to linear, 1–2.5 mm wide, less than three-nerved..... 4
         4. Stems few or solitary from an underground base; basal leaves ciliate and usually pubescent on the upper leaf surface, usually numerous at anthesis.... 4. *H. canadensis*
         4. Stems numerous from an underground base; basal leaves usually absent, if present eciliate.....5. *H. longifolia*

Of Ohio's species of *Houstonia*, only *H. caerulea* and *H. nigricans* are taxonomically well defined species. All other members of the genus are part of a complex generally referred to as the "*Houstonia purpurea* group", which has been divided into a number of varieties and/or species by several authors. Specific and infraspecific rank has been based almost entirely on shape and texture of leaves and stems. Examination of herbarium specimens in Ohio suggests that all taxa in question form an intergrading series.

Terrell, while doing preliminary herbarium work on the *H. purpurea* group in 1948, indicated by his annotations on herbarium specimens that the Ohio portion of the complex consisted of these species: *H. purpurea*, *H. canadensis*, and *H. tenuifolia*. In 1956, after completing extensive herbarium and field work, Terrell annotated several Ohio specimens either as hybrids or as intergrades between *H. purpurea* and *H. tenuifolia*.

In 1959, Terrell published a revision of the *H. purpurea* group, but in doing so created a source of confusion among Ohio herbarium specimens. His treatment in the revision excluded *H. tenuifolia* and included *H. longifolia* as part of Ohio's flora; however no re-annotation of herbarium specimens was attempted. According to Terrell's 1959 revision of the group, intergrades should have been annotated as intermediates between *H. purpurea* and *H. longifolia*. A quote from Terrell's paper sums up the problem.

> Intergrades in this present grouping have been annotated generally by the writer in the past as between *H. purpurea* and *H. tenuifolia*, because it was earlier believed that *H. longifolia* var. *compacta* should be considered a subspecies of *H. tenuifolia*.

Accordingly, all herbarium specimens annotated as *H. tenuifolia* by Terrell have been re-annotated by myself as *H. longifolia*. Because I am aware that I am in no position to designate a particular intergrade as being the product of hybridization, those specimens annotated by Terrell as *H. purpurea* X *H. tenuifolia* as well as specimens annotated by him as intergrades between these two species, have been annotated simply as intergrades between *H. purpurea* and *H. longifolia*. A distribution map is not included for the intergrades, but they are included in the following discussion of the genus.

1. *Houstonia caerulea* L. (Bluets, Quaker-ladies)
   Houstonia faxonorum Fern.
   Common. Generally restricted to the eastern and southern portions of Ohio. Along roadsides, in moist, grassy meadows and open fields, often found in association with mossy habitats in moist, open woods and on rocky ledges. April-June, occasionally throughout the summer and early fall. Native.
2. *Houstonia nigricans* (Lam.) Fern.
   Houstonia angustioflium Michx.
   Infrequent. The only stations known for the state are from Adams and Ottawa counties. Found on dry soils of well-eroded rocks and dry, shallow soils on crumbling shales and limestone rocks. July-October. Native.
3. *Houstonia purpurea* L. (Purple Bluets)
   Infrequent. Restricted to the Ohio River Valley in the southern portion of Ohio. Found in dry soils on rocky slopes and in dry, open woods. May-June. Native.
4. *Houstonia canadensis* Willd. (Canadian Bluets)
   Houstonia ciliolata Torr.
   Frequent. Widely scattered throughout the state, more common in the central and southern parts of Ohio. Found on calcareous soils of moist, open woods, shale banks, and wooded, stream banks. May-August. Native.
5. *Houstonia longifolia* Gaertn.
   Frequent. Most common in the southeastern portion of the state. Found on dry soils in thin woods, on hillsides, rocky slopes, and shallow soil of shale banks. June-September. Native.
6. Intergrade between *H. purpurea* and *H. longifolia*
   Generally restricted to the Ohio River Valley. Found on dry rocky soils of hillsides, rocky slopes and outcrops, and dry open woods.

The intergrades I examined were generally characterized by several features. Leaf shape varied from broadly linear to elliptical, the width of the leaf averaging about 2.5 mm. All leaves were one-nerved. Stem vesture was usually dense pubescence. Occasionally the pubescence decreased in the middle of the stem, the upper internodes becoming glabrous. The corolla lobes were pubescent within and sepals were occasionally ciliate. Specimens of intergrades were examined from the following countries: Adams, Auglaize, Clermont, Coshocton, Hamilton, Preble, and Warren.

SPERMACOCE L. (Buttonweed)

1. *Spermacoce glabra* Michx.
   Rare. Restricted to the Ohio River Valley. Low, wet woods and river banks. June-October. Native.

HAMILTON: Fulton, river bank, Marcus Kreke, 1917, (CINN); Sweetvine, rocky river banks of Ohio R., E. L. Braun, (CINN), (OS).
LAWRENCE: Fayette Twp., near Burlington, along banks of the Ohio R., Clara Weishaupt, Sept. 21, 1955, (OS); Kenova, in a mud flat along the Ohio R., Floyd Bartley & Lawrence E.

Hicks, Sept. 19, 1954, (OS); Southeast of Ironton, muddy open shore of Ohio R., G. W. Hall, Floyd Bartley and Donald Macbeth, Sept. 19, 1954, (OU).

DIODIA L. (Buttonweed)

KEY TO SPECIES

1. Sepals four; corolla funnelform; style entire.....1. *D. teres*
2. Sepals two; corolla not funnelform, with a filiform tube; style two-cleft...2. *D. virginiana*

1. *Diodia teres* Walt.
   Infrequent. Widely scattered throughout most of the state except northwestern part. Found in dry upland meadows, along cinders of railroad embankments, and dry sunny hillsides, especially common by the wayside. Flowering throughout the summer and early fall. Native.
2. *Diodia virginiana* L.
   Rare. Confined to wet streambanks of the Ohio River. Flowering throughout the summer. Native.

ADAMS: Manchester, collected on Ohio River banks, Floyd Bartley, August 7, 1949, (OS); no location given, along the shore of the Ohio River, Conrad Roth, October 12, 1932, (OS).
LAWRENCE: Fayette Twp., Ohio River banks at Burlington, Clara Weishaupt, Sept. 21, 1955, (OS); Kenova, on a mudflat along the Ohio River, Floyd Bartley and Lawrence Hicks, Sept. 19, 1954, (OS); Irontown, muddy open shore of Ohio River, G. W. Hall, Floyd Bartley, and Donald Macbeth, Sept. 19, 1954, (OU).

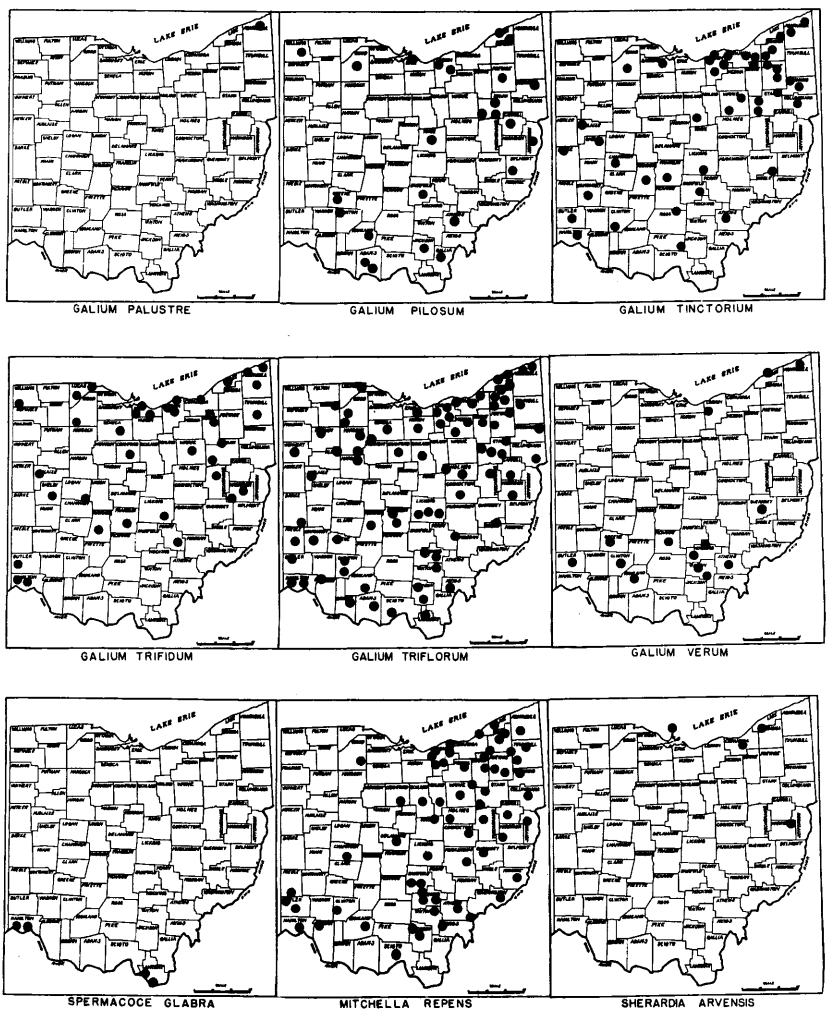

FIGURE 3. Distribution maps of species of *Galium*, *Mitchella*, *Sherardia*, and *Spermacoce* in Ohio.

LIST OF EXCLUDED SPECIES

Galium latifolium Michx.—This species was reported from Adams County by Braun (1928); however, no herbarium specimens were found. Other specimens from other parts of the state were determined to be *G. lanceolatum*. The range of *G. latifolium* according to Fernald (1950) is from the mountains of Penn. and W. Virginia to Alabama and Tennessee.

Houstonia lanceolata (Poir.) Britt.—The specimens from Clinton and Pike Counties, originally cited by Schaffner (1932) have been re-identified as *H. purpurea* by E. E. Terrell and myself. A specimen from Hamilton County has been determined to be an intergrade between *H. purpurea* and *H. longifolia*.

Houstonia tenuifolia Nutt.—This species was included in the vascular plant flora of Vinton and Jackson Counties by Bartley and Beatley (1959); it is possible that they followed Terrell's 1948 annotations in using the name *H. tenuifolia*. The present study indicates the plant they list is doubtless what Terrell, in his actual revision previously cited in the *Houstonia* section, and I call *H. longifolia*.

TABLE 2

Statistical summary of the Rubiaceae based on the frequency of occurrence in each genus.

Genus	Rare	Infrequent	Frequent	Common	Total
Asperula	1	0	0	0	1
Cephalanthus	0	0	0	1	1
Diodia	1	1	0	0	2
Galium	2	5	4	4	15
Houstonia	0	2	2	1	5
Mitchella	0	0	0	1	1
Sherardia	1	0	0	0	1
Spermacoce	1	0	0	0	1
Family Totals	6	8	6	7	27

LITERATURE CITED

Braun, E. L. 1928. The vegetation of the Mineral Springs Region of Adams County, Ohio. Ohio Biol. Survey 32: 451.

Bartley, F. and **J. C. Beatley.** 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull Ohio Biol. Survey 1: 170–182.

Cave, M. S. et. al. 1958–60. Index to Plant Chromsome Numbers, Vol. 1. Chapel Hill, N. Carolina. Univ. of N. Carolina Press. 299 p.

Darlington, C. D. and **A. P. Wylie.** 1956. Chromosome Atlas of Flowering Plants. New York. The Macmillan Co. 519 p.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed. New York. The American Book Co. 1632 p.

Fosberg, F. R. 1954. Notes on plants of the eastern United States. Castanea 19: 25–37.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada, Vol. 3. Lancaster, Pa. Lancaster Press. 589 p.

Jinno, T. 1956. On the relation between the chromosome numbers and the flora growing in the coast of the island sea of Japan. Jap. J. Gene. 31: 147–150.

Lanjouw, J. and **F. A. Stafleu.** 1959. Index Herbariorum. The Herbaria of the World, 4th ed. Regnum Vegetabile 15: 188–211.

Lawrence, G. H. 1951. Taxonomy of Vascular Plants. New York. The Macmillan Co. 823 p.

Lewis, W. H. 1961. Merger of the North American *Houstonia* and *Oldenlandia* under *Hedyotis*. Rhodora 63: 216–223.

———. 1962. Chromsome numbers in North American Rubiaceae. Brittonia 14: 285–290.

Löve, A. and **D. Löve.** 1954. Cytotaxonomic studies on the northern bedstraws. Am. Midland Natural. 52: 88–105.

Schaffner, J. H. 1932. Revised catalog of Ohio vascular plants. Ohio Biol. Survey 36: 190–193.

Skalinska, M. R. et. al. 1959. Further studies in chromosome numbers of Polish Angiosperms (Dicotyledons). Acta Polsk. Towarz. Bot. 28: 487–529.

Terrell, E. E. 1959. A revision of the *Houstonia purpurea* group. Rhodora 61: 157–180, 188–207.